(12) UK Patent Application (19) GB (11) 2 345 209 (13) A

(43) Date of A Publication 28.06.2000

(21) Application No 9930192.1

(22) Date of Filing 21.12.1999

(30) Priority Data
(31) S981093 (32) 22.12.1998 (33) IE
(31) S990724 (32) 25.08.1999

(71) Applicant(s)
Hi-Key Limited
(Incorporated in Ireland)
IDA Industrial Estate, Dunmore Road, Tuam,
County Galway, Ireland

(72) Inventor(s)
Patrick John Lyons

(74) Agent and/or Address for Service
Mewburn Ellis
York House, 23 Kingsway, LONDON, WC2B 6HP,
United Kingdom

(51) INT CL[7]
H05K 9/00 , H01Q 1/48 , H04B 1/10

(52) UK CL (Edition R)
H3Q QAK Q1A Q1H
H1Q QCH
U1S S1843 S2205

(56) Documents Cited
GB 2293050 A GB 2258962 A US 5608611 A

(58) Field of Search
UK CL (Edition R) H1Q QCH QCX , H3Q QAA QAK
INT CL[7] H04B 1/08 1/10 , H05K 9/00

(54) Abstract Title
A vehicle access radio receiver with a printed antenna and an earthed shield

(57) A radio receiver for a keyless entry security system comprises a printed circuit board 2 which supports both an aerial printed circuit track 8 and a shielded radio receiving circuit. A connecting lug 18 is provided on the shielding box 10 for earthing to the vehicle body. The shielding box is connected by tabs extending through holes 17 to an earth plane on the reverse of the PCB. A plate (31, figure 5) may extend from the shield to provide a ground reference plane for the antenna. The side 12,13 of the shielding box adjacent the aerial may also act as an earth reference plane.

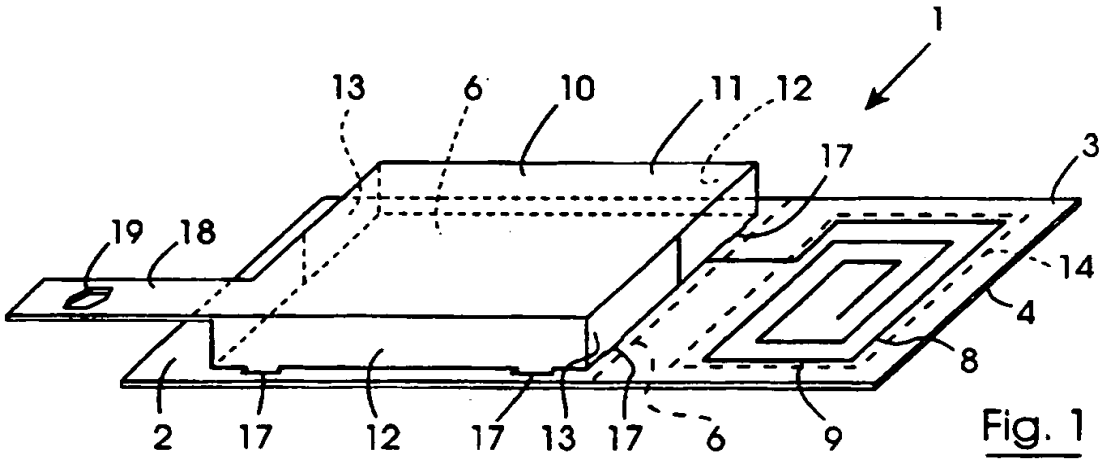

Fig. 1

GB 2 345 209 A

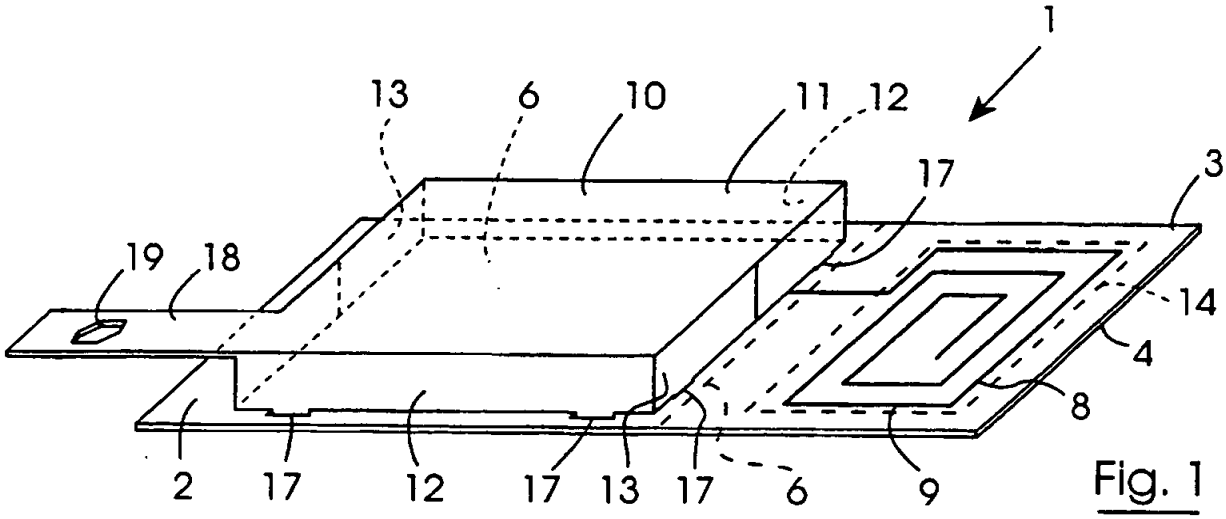

Fig. 1

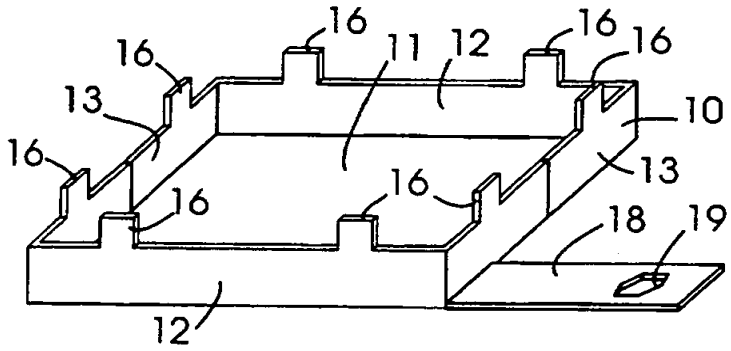

Fig. 3

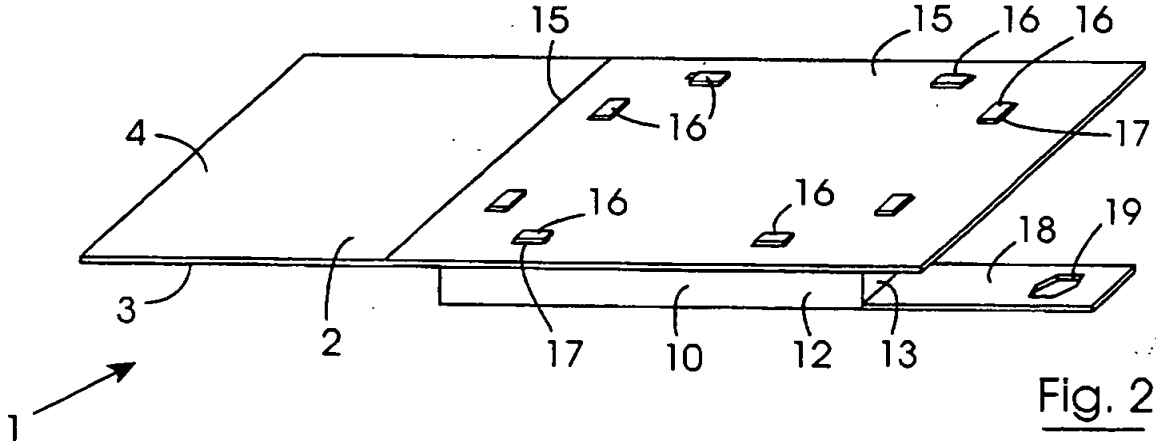

Fig. 2

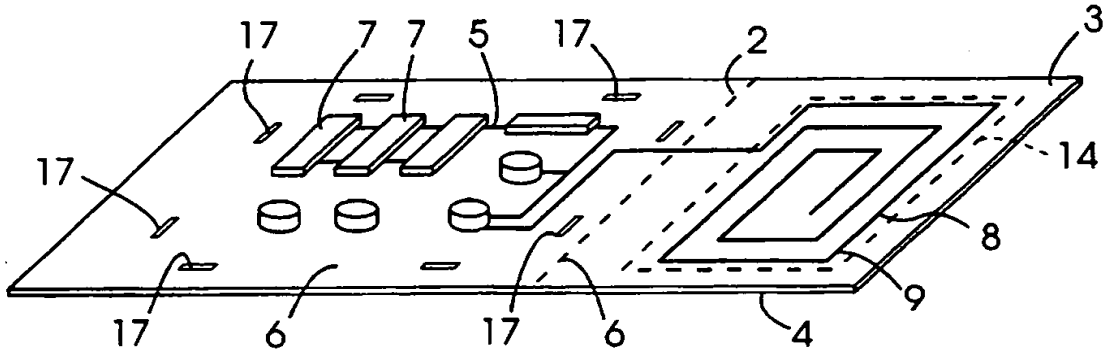
17
7
7
5
17
2
3
17
14
8
9
17
6
17
6
4

Fig. 4

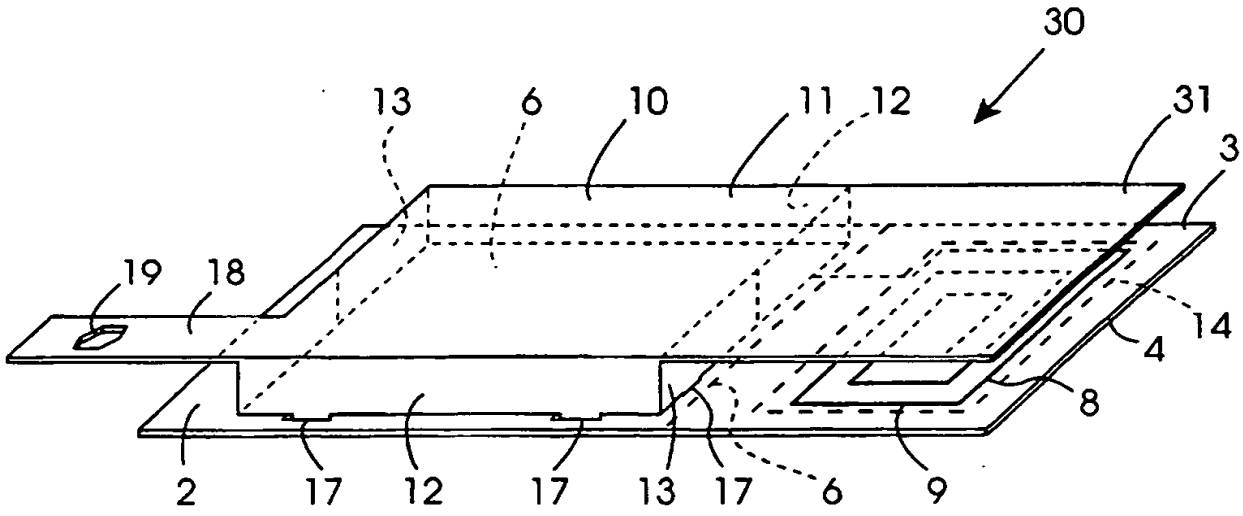
30
13
6
10
11
12
31
3
19
18
14
4
8
2
17
12
17
13
17
6
9

Fig. 5

"A radio receiver"

The present invention relates to a radio receiver, and in particular, though not limited to radio receiver for use in a vehicle, for example, for use in connection with a security system, such as a keyless entry security system of a motor vehicle.

Keyless entry systems for motor vehicles are well known, as are security systems for motor vehicles. Security systems in general comprise a central electronic control unit which in general, controls a number of circuits of the security system. For example, the central control unit may control a vehicle immobiliser for immobilising the vehicle by, for example, isolating the ignition system of the vehicle from the battery, and/or by isolating the fuel injection or carburation system of the vehicle from the fuel tank. The central control unit, in general, also controls an alarm circuit for sounding an alarm in the event of an unauthorised entry or an attempted unauthorised entry being made to the vehicle. It is also common for the central control unit to operate a control circuit for the central locking system of the vehicle.

In general, when the security system controls the central locking system of the vehicle, the security system is provided as a keyless entry system, and is thus armed and disarmed by reception of a radio frequency signal, which typically, is transmitted by a key fob transmitter. In such cases, the central electronic control unit comprises a radio receiver for receiving the transmitted signal, or alternatively, a stand alone radio receiver may be provided which inputs the received signal to the central electronic control unit. In general, the radio receiver, whether it is provided in a stand alone form or incorporated in the central electronic control unit is located in the

vehicle, and typically, within the engine compartment. In which case components of the radio receiver are subjected to significant interference from the electrical and electronic systems of the motor vehicle. Such interference can lead to failure of the security system, and may also lead to false alarms. Additionally, such interference may also interfere with the reception of arming and disarming signals by the radio receiver. While attempts have been made to minimise the effects of such interference, such attempts have not been entirely successful.

There is therefore a need for a radio receiver which overcomes the problems of known receivers.

The present invention is directed towards providing such a radio receiver, as well as a security system for a vehicle incorporating the radio receiver, and the present invention is also directed towards an antenna for a radio receiver.

According to the invention there is provided a radio receiver for a security system of a motor vehicle, the radio receiver comprising a printed circuit board having a plurality of electronic components mounted thereon connected by electrically conductive tracks printed thereon forming a radio receiving circuit, and an antenna formed by an electrically conductive track on the printed circuit board for receiving radio frequency signals, the antenna being electrically connected to the radio receiving circuit, an electrically conductive shielding means located on the printed circuit board for shielding the components thereon, and an electrically conductive connecting means extending directly from the shielding means for connecting the

shielding means to ground, the connecting means being adapted for connecting to a grounded portion of the vehicle.

Preferably, the connecting means is adapted for connecting directly to the body of the vehicle.

In one embodiment of the invention the connecting means comprises a ground lug extending from the shielding means. Preferably, the connecting means is integrally formed with the shielding means. Advantageously, an opening is provided in the connecting means for accommodating a screw for connecting and securing the connecting means to ground. Ideally, the connecting means is formed from sheet material. Preferably, the sheet material forming the connecting means is sheet metal.

In one embodiment of the invention the connecting means is of length at least 30mm. Preferably, the connecting means is of length approximately 40mm.

In another embodiment of the invention the connecting means is of width at least 10mm. Preferably, the connecting means is of width approximately 12mm.

In one embodiment of the invention an electrically conductive ground plane is formed on the printed circuit board on the side opposite to that on which the components are mounted.

In another embodiment of the invention the shielding means is electrically connected to the ground plane so that the components on the printed circuit board are completely enshrouded by a combination of the shielding means and the ground plane.

In a further embodiment of the invention a securing means is provided for securing the shielding means to the printed circuit board. Preferably, the securing means is adapted for extending through the printed circuit board for securing the shielding means to the printed circuit board. Advantageously, the securing means are of electrically conductive material. Ideally, the securing means is integrally formed with the shielding means. Preferably, the securing means is adapted for electrically engaging the ground plane.

In one embodiment of the invention the securing means comprises a plurality of securing tabs.

In another embodiment of the invention the shielding means comprises a housing, and preferably, the housing is formed of sheet metal material.

In one embodiment of the invention the housing comprises a top wall and a pair of spaced apart side walls extending from the top wall, and a pair of spaced apart end walls extending from the top wall between the side walls and joining the respective side walls, and preferably, at least one securing means extends from each side wall and each end wall.

In another embodiment of the invention the shielding means is located relative to the antenna such that a part of the shielding means acts to form a ground referencing means for the antenna.

In a further embodiment of the invention the antenna is printed on the printed circuit board on the same side as the components. Preferably, the antenna is connected to the radio receiving circuit by an electrically conductive track extending between the antenna and the radio receiving circuit. Advantageously, the antenna is printed on the printed circuit board on a portion thereof which extends outwardly of the shielding means. Ideally, the antenna is printed on the printed circuit board relatively closely to the shielding means.

In one embodiment of the invention the spacing between the shielding means and the antenna does not exceed 10mm.

In another embodiment of the invention the spacing between the shielding means and the antenna does not exceed 5mm.

Additionally or alternatively the ground referencing means is electrically connected to and extends from the shielding means adjacent to but spaced apart from the antenna. Preferably, the ground referencing means is of electrically conductive sheet material.

In one embodiment of the invention the ground referencing means comprises a ground reference panel extending from the shielding means. Preferably, the ground

reference panel extends parallel to the printed circuit board on which the antenna is printed. Advantageously, the ground referencing means is of area at least equal to the area of the printed circuit board taken up by the antenna, and preferably, the ground referencing means is of area greater than the area of the printed circuit board taken up by the antenna.

In one embodiment of the invention the spacing between the ground referencing means and the antenna lies in the range of 10mm to 30mm.

In another embodiment of the invention the spacing between the ground referencing means and the antenna lies in the range of 12mm to 20mm.

In a further embodiment of the invention the spacing between the ground referencing means and the antenna is approximately 15mm.

In one embodiment of the invention the radio receiver is adapted for mounting in a vehicle.

In another embodiment of the invention the radio receiver is adapted for use in conjunction with a central electronic control unit of a security system of a motor vehicle.

Further the invention provides a security system for a vehicle, the security system comprising the radio receiver according to the invention.

Additionally, the invention provides an antenna for a radio receiver, the antenna being formed by an electrically conductive track on a printed circuit board, and a ground referencing means being located adjacent to but spaced apart from the antenna for forming a ground referencing means to the antenna.

The invention will be more clearly understood from the following description of some preferred embodiments thereof which are given by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a radio receiver according to the invention,

Fig. 2 is another perspective view of the radio receiver of Fig. 1,

Fig. 3 is a perspective view of a portion of the radio receiver of Fig. 1,

Fig. 4 is a perspective view of another portion of the radio receiver of Fig. 1, and

Fig. 5 is a perspective view similar to Fig. 1 of a radio receiver according to another embodiment of the invention.

Referring to the drawings and initially to Figs. 1 to 4 there is illustrated a radio receiver, according to the invention indicated generally by the reference numeral 1. The radio receiver 1 is particularly suitable for mounting in a motor vehicle for use with an electronic central control unit of a security system for receiving arming and

disarming signals from a key fob transmitter for arming and disarming the security system. The radio receiver 1 comprises a printed circuit board 2 having a top side 3 and a bottom side 4. The top side 3 of the printed circuit board 2 is patterned with electrically conductive tracks 5 in an area 6 for interconnecting a plurality of components 7 which form a radio receiving circuit. An antenna 8 which is formed by an electrically conductive track 9 printed on the top side 3 of the printed circuit board 2 in an area 14 is connected to the radio receiving circuit by one end of the electrically conductive track 9. Such construction of a radio receiver printed circuit board will be well known to those skilled in the art.

A shielding means for electrically shielding the components on the printed circuit board 2 comprises an electrically conductive sheet metal housing 10 mounted on the top side 3 of the printed circuit board 2 in the area 6. The housing 10 is integrally formed in one piece from a sheet of sheet metal and comprises a top wall 11 and a pair of spaced apart side walls 12 extending from the top wall 11, and spaced apart end walls 13 also extending from the top wall 11, and joining the side walls 12. The area of the top wall 11 is such as to completely enclose the area 6 containing the radio receiving circuit so that the entire circuitry of the radio receiver 1, with the exception of the antenna 8 is shielded by the housing 10.

An electrically conductive ground plane 15 is printed on the bottom side 4 of the board 2 and covers an area slightly greater than the area covered by the housing 10. A securing means which comprises two electrically conductive securing tabs 16 extending from each of the side and end walls 12 and 13 through openings 17 in the printed circuit board 2 secure the housing 10 to the printed circuit board 2. The

securing tabs 16 electrically engage the ground plane 15 so that the components 7 and electrically conductive tracks 5 in the area 6 of the radio receiving circuit are completely enclosed by the housing 10 in combination with the ground plane 15. In this way the components 7 and the electrically conductive tracks 5 in the area 6 are completely electrically shielded from external interference and emissions. The securing tabs 16 are of sheet metal and are integrally formed with the housing 8 from the same sheet of sheet metal.

An electrically conductive connecting means for grounding the housing 10 to the vehicle comprises a ground lug 18 which extends from the housing 10 and is integrally formed therewith from the same sheet of sheet metal. An opening 19 extending through the ground lug 18 is provided for receiving a screw for securing the ground lug 18 directly onto a grounded portion of the vehicle, typically, the vehicle body. The ground lug 18 extends a distance of approximately 40mm from the housing 10 and is of width approximately 12mm. The provision of the ground lug 18 ensures that the housing 10 is adequately grounded, and furthermore, that the ground plane 15 is also adequately grounded.

Additionally, the housing 10 is located relatively closely to the antenna 8 for acting as a ground referencing means for the antenna 8 for providing the antenna 8 with a ground reference. This it has been found in many cases significantly enhances the performance of the radio receiver 1, and in particular, enhances the reception of radio frequency signals by the receiver 1. In this embodiment of the invention the end wall 13 which is closest to the antenna 8 is approximately 5mm from the nearest track of the antenna 8. It is believed that the significant enhancement of reception of

radio frequency signals by the radio receiver 1 is provided by a combination of the proximity of the housing 10 to the antenna 8 and the fact that a particularly good grounding of the housing 10 is achieved by the provision of the ground lug 18.

Referring now to Fig. 5 of the drawings a radio receiver according to another embodiment of the invention which is indicated generally by the reference numeral 30 is illustrated. The radio receiver 30 is also suitable for mounting in a motor vehicle for use with an electronic central control unit of a security system, and is substantially similar to the radio receiver 1, and similar components are identified by the same reference numerals. The main difference between the radio receiver 30 and the radio receiver 1 is that in this embodiment of the invention the ground referencing means is provided by an electrically conductive ground reference panel 31 extending from the housing 10. The ground reference panel 31 is integrally formed with the housing 10 of the same sheet metal as the housing 10. The ground reference panel 31 extends substantially parallel to the plane of the antenna 8 and is spaced apart therefrom a distance of approximately 15mm.

As well as the housing 10, the ground reference panel 31 forms an additional ground reference for the antenna 8, and it has been found that the provision of the ground reference in the form of the ground reference panel 31 in many cases enhances reception of radio frequency signals by the receiver 1, and minimises the effect of interference on the antenna. Although, in certain cases preferred results are achieved without the ground reference panel 31. In cases where it is desirable to provide the ground reference panel 31, it has been found in particular that where the area of the ground reference panel 31 is similar to or greater than the area of the

printed circuit board 2 taken up by the antenna 8 particularly good results are achieved. The area of the printed circuit board 2 taken up by the antenna 8 is indicated by the broken lines 14, and as can be seen, the area of the ground reference panel 31 in this embodiment of the invention is greater than the area bounded by the broken lines 14.

While the shielding means and the ground referencing means have been described as being provided by an electrically conductive metal, the shielding means and the ground referencing means may be provided by any other suitable electrically conductive material, for example, metallised plastics material or the like. It will also of course be appreciated that while it is preferable to provide a ground plane on the bottom side of the printed circuit board, and to electrically connect the shielding means thereto so that the radio receiving circuit is completely electrically shielded, the ground plane may be omitted from the printed circuit board.

Claims

1. A radio receiver for a security system of a motor vehicle, the radio receiver comprising a printed circuit board having a plurality of electronic components mounted thereon connected by electrically conductive tracks printed thereon forming a radio receiving circuit, and an antenna formed by an electrically conductive track on the printed circuit board for receiving radio frequency signals, the antenna being electrically connected to the radio receiving circuit, an electrically conductive shielding means located on the printed circuit board for shielding the components thereon, and an electrically conductive connecting means extending directly from the shielding means for connecting the shielding means to ground, the connecting means being adapted for connecting to a grounded portion of the vehicle.

2. A radio receiver as claimed in Claim 1 in which the connecting means is adapted for connecting directly to the body of the vehicle.

3. A radio receiver as claimed in Claim 1 or 2 in which the connecting means comprises a ground lug extending from the shielding means.

4. A radio receiver as claimed in any preceding claim in which the connecting means is integrally formed with the shielding means.

5. A radio receiver as claimed in any preceding claim in which an opening is provided in the connecting means for accommodating a screw for connecting and securing the connecting means to ground.

6. A radio receiver as claimed in any preceding claim in which the connecting means is formed from sheet material.

7. A radio receiver as claimed in Claim 6 in which the sheet material forming the connecting means is sheet metal.

8. A radio receiver as claimed in any preceding claim in which the connecting means is of length at least 30mm.

9. A radio receiver as claimed in Claim 8 in which the connecting means is of length approximately 40mm.

10. A radio receiver as claimed in any preceding claim in which the connecting means is of width at least 10mm.

11. A radio receiver as claimed in Claim 10 in which the connecting means is of width approximately 12mm.

12. A radio receiver as claimed in any preceding claim in which an electrically conductive ground plane is formed on the printed circuit board on the side opposite to that on which the components are mounted.

13. A radio receiver as claimed in Claim 12 in which the shielding means is electrically connected to the ground plane so that the components on the printed

circuit board are completely enshrouded by a combination of the shielding means and the ground plane.

14. A radio receiver as claimed in any preceding claim in which a securing means is provided for securing the shielding means to the printed circuit board.

15. A radio receiver as claimed in Claim 14 in which the securing means is adapted for extending through the printed circuit board for securing the shielding means to the printed circuit board.

16. A radio receiver as claimed in Claim 14 or 15 in which the securing means are of electrically conductive material.

17. A radio receiver as claimed in any of Claims 14 to 16 in which the securing means is integrally formed with the shielding means.

18. A radio receiver as claimed in any of Claims 14 to 17 in which the securing means is adapted for electrically engaging the ground plane.

19. A radio receiver as claimed in any of Claims 14 to 18 in which the securing means comprises a plurality of securing tabs.

20. A radio receiver as claimed in any preceding claim in which the shielding means comprises a housing.

21. A radio receiver as claimed in Claim 20 in which the housing is formed of sheet metal material.

22. A radio receiver as claimed in Claim 20 or 21 in which the housing comprises a top wall and a pair of spaced apart side walls extending from the top wall, and a pair of spaced apart end walls extending from the top wall between the side walls and joining the respective side walls.

23. A radio receiver as claimed in Claim 22 in which at least one securing means extends from each side wall and each end wall.

24. A radio receiver as claimed in any preceding claim in which the shielding means is located relative to the antenna such that a part of the shielding means acts to form a ground referencing means for the antenna.

25. A radio receiver as claimed in Claim 24 in which the antenna is printed on the printed circuit board on the same side as the components.

26. A radio receiver as claimed in Claim 24 or 25 in which the antenna is connected to the radio receiving circuit by an electrically conductive track extending between the antenna and the radio receiving circuit.

27. A radio receiver as claimed in any of Claims 24 to 26 in which the antenna is printed on the printed circuit board on a portion thereof which extends outwardly of the shielding means.

28. A radio receiver as claimed in any of Claims 24 to 27 in which the antenna is printed on the printed circuit board relatively closely to the shielding means.

29. A radio receiver as claimed in any of Claims 24 to 28 in which the spacing between the shielding means and the antenna does not exceed 10mm.

30. A radio receiver as claimed in Claim 29 in which the spacing between the shielding means and the antenna does not exceed 5mm.

31. A radio receiver as claimed in any of Claims 24 to 30 in which the ground referencing means is electrically connected to and extends from the shielding means adjacent to but spaced apart from the antenna.

32. A radio receiver as claimed in Claim 31 in which the ground referencing means is of electrically conductive sheet material.

33. A radio receiver as claimed in Claim 31 or 32 in which the ground referencing means comprises a ground reference panel extending from the shielding means.

34. A radio receiver as claimed in Claim 33 in which the ground reference panel extends parallel to the printed circuit board on which the antenna is printed.

35. A radio receiver as claimed in any of Claims 31 to 34 in which the ground referencing means is of area at least equal to the area of the printed circuit board taken up by the antenna.

36. A radio receiver as claimed in Claim 35 in which the ground referencing means is of area greater than the area of the printed circuit board taken up by the antenna.

37. A radio receiver as claimed in any of Claims 31 to 36 in which the spacing between the ground referencing means and the antenna lies in the range of 10mm to 30mm.

38. A radio receiver as claimed in Claim 37 in which the spacing between the ground referencing means and the antenna lies in the range of 12mm to 20mm.

39. A radio receiver as claimed in Claim 38 in which the spacing between the ground referencing means and the antenna is approximately 15mm.

40. A radio receiver as claimed in any preceding claim in which the radio receiver is adapted for mounting in a vehicle.

41. A radio receiver as claimed in any preceding claim in which the radio receiver is adapted for use in conjunction with a central electronic control unit of a security system of a motor vehicle.

42. A radio receiver substantially as described herein with reference to and as illustrated in Figs. 1 to 4 of the accompanying drawings.

43. A radio receiver substantially as described herein with reference to and as illustrated in Fig. 5 of the accompanying drawings.

44. A security system for a vehicle, the security system comprising the radio receiver as claimed in any preceding claim.

45. An antenna for a radio receiver, the antenna being formed by an electrically conductive track on a printed circuit board, and a ground referencing means being located adjacent to but spaced apart from the antenna for forming a ground referencing means to the antenna.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 9930192.1 **Examiner:** Keith Sylvan
Claims searched: 1-44 **Date of search:** 17 April 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H3Q (QAA,QAK) H1Q (QCH,QCX)

Int Cl (Ed.7): H05K (9/00) H04B (1/08,1/10)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2293050 A	Valeo. See the abstract.	-
A	GB2258962 A	Electronic Advanced Research. See figure 2.	-
A	US5608611	United Technologies/Ford. See the abstract.	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.